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Impacts of atmospheric rivers on the hydrometeorology of the Euphrates-Tigris Basin in the snowmelt season

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Atmospheric rivers (ARs) are important components of the global water cycle as they are responsible for over 90% of the poleward moisture transport at middle to high latitudes. ARs travelling thousands of kilometers over arid North Africa could interact with the highlands of the Mesopotamia and thus affect the hydrometeorology and water resources of the Euphrates-Tigris Basin. Here, we use a state-of-the-art AR tracking database, and reanalysis and observational datasets to investigate the climatology (1979-2017) and influences of these ARs in snowmelt season (March-April). The Red Sea and northeast Africa are found to be the major source regions of these ARs, which are typically associated with the eastern Mediterranean trough positioned over the Balkan Peninsula and a blocking anticyclone over the Near East-Caspian region, triggering southwesterly air flow towards the highlands of the Euphrates-Tigris Basin. AR days exhibit enhanced precipitation over the crescent-shaped orography of the Euphrates-Tigris Basin. Mean AR days indicate wetter (up to +2 mm day^{-1}) and warmer (up to +1.5^{o}C) conditions than all-day climatology. On AR days, while snowpack tends to decrease (up to 30%) in the Zagros Mountains, it can show decreases or increases in the Taurus Mountains depending largely on elevation. A further analysis with the aid of observations and reanalysis for the three extreme AR events indicates that ARs coinciding with large scale sensible heat transport can have notable impacts on the surface hydrometeorological conditions such as snowmelt, rain-on-snow precipitation and increasing daily discharges of the Euphrates and Tigris rivers. These results suggest that ARs can have notable impacts on the hydrometeorology and water resources of the basin, particularly of lowland Mesopotamia, a region that is famous with great floods in the ancient narratives.